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REVIEW

Enhancing sweet potato (*Ipomoea batatas* L.) production in Europe: a case study of home gardening in Hungary

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Abstract

Home gardening plays a crucial role in developing a robust agri-food system. Although it is performed as a leisure activity, it tends to yield significant benefits that transcend the nutritional, health, socioeconomic, and ecological aspects of life. Sweet potato (*Ipomoea batatas*) is a versatile root tuber crop rich in dietary fiber, carbohydrates, vitamins, and anthocyanins. In several European countries, including Hungary, the demand for this crop among consumers is growing. However, production has been significantly limited in these countries, resulting in imports from other continents to satisfy consumer demand. Incorporating sweet potatoes into home gardening has significant benefits, including increased crop production and yield. Through a thorough synthesis and analysis of information from relevant literature, the Scopus database, and the Food and Agriculture Organization of the United Nations (FAO) database, this review promotes the adoption of sweet potato as a garden crop in Hungary. It begins with global trends in research on home gardens and sweet potato production. This is followed by comprehensive information on crop description, uses, benefits, and propagation methods. It also presents information on the benefits of adopting sweet potato as a garden crop and simplified cultivation techniques for home gardeners. The strategic framework for achieving this goal is also highlighted for responsible stakeholders. The findings of this study could serve as a blueprint for advancing sweet potato production in other European countries.

Keywords Ecological · Health · Home garden · *Ipomoea batatas* (L.) lam · Socioeconomic development

Introduction

Home gardening is a vital component of local food systems and contributes significantly to household food security and nutrition. This is particularly relevant in the context of economic transition and urbanization, where home gardens serve as a buffer against food insecurity, serving as a source of fresh produce for healthy eating (Algert et al. 2016; Laurie et al. 2017; Phulkerd et al. 2020). The environmental benefits of home gardening are also significant. Gardens contribute to urban greening efforts, improve air quality, and support local biodiversity by providing habitats for various species (Porter 2018; Chablé-Pacual et al. 2021; Mulia et al. 2022; Varga-Szilay et al. 2023). Furthermore, home gardens can mitigate the impacts of climate change by sequestering carbon and promoting sustainable land-use practices (Jamuna et al. 2015). In recent years, home gardening has gained popularity, partly due to the COVID-19 pandemic, which heightened awareness of food supply vulnerabilities and the benefits of self-sufficiency (Nicola et al.

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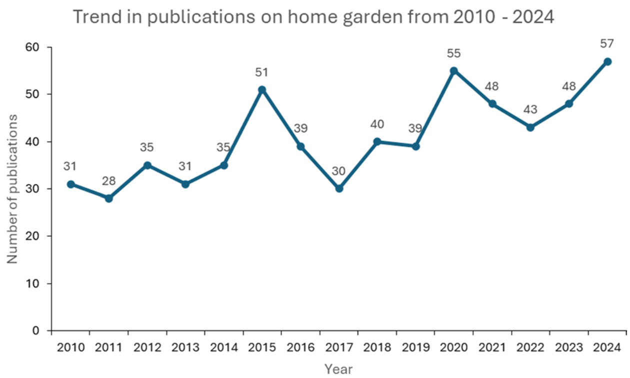

Fig. 1 Trends in publications on home gardens from 2010 to 2024 (Source: Scopus database)

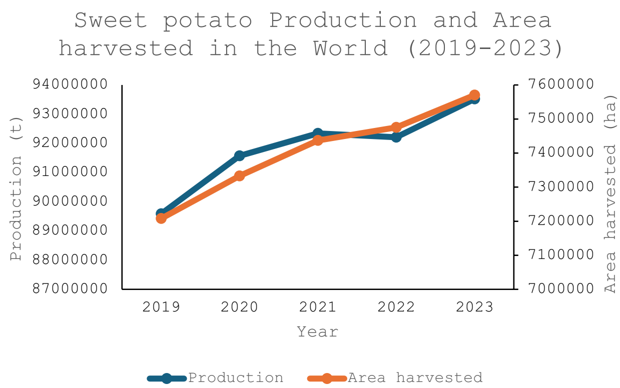

Fig. 2 Trend in sweet potato production (2019–2023) indicating production quantity and area harvested. (Source: FAO 2025)

2020; Asante et al. 2024). Many households have turned to gardening as a means of coping with the uncertainties of the pandemic, leading to a resurgence of interest in growing fruits and vegetables at home (Kegler et al. 2020; Mullins et al. 2021; Music et al. 2022; Diekmann et al. 2024). These benefits underscore the upward trend in research publications on home gardening (Fig. 1). Among the various crops integrated into these home gardens, sweet potato (*Ipomoea batatas* L.) has emerged as a promising option because of its nutritional and ecological benefits.

Sweet potatoes are among the most valuable food crops worldwide because they offer significant domestic and industrial benefits. As an angiosperm and perennial root tuber, it is unique among other species in the *Convolvulaceae* family (Behera et al. 2022). Although sweet potatoes have existed in Europe for over a century, they have become prominent in Hungary in the past two decades. However, they have received increasing interest from consumers and researchers (Monostori and Szarvas 2015). The nutritional profile of sweet potatoes is a key driver of their increasing popularity and utilization in several cuisines. They are rich in dietary carotenoids, vitamins, and minerals, making them excellent sources of nutrients (Laveriano-Santos et al. 2022). Sweet potatoes are known for their high beta-carotene content, which is a precursor of vitamin A, as well as vitamins B6 and C (Abewoy 2023). Purple-fleshed varieties are particularly noted for their anthocyanin content, which has been associated with various health benefits, including antioxidant and anti-inflammatory properties (Bennett et al. 2021; Mattoo et al. 2022). These nutritional advantages have led to a growing market for sweet potatoes in Europe, where health-conscious consumers increasingly seek nutrient-dense foods.

Despite the growing market for sweet potatoes, their yield has been consistently low in Europe, accounting for only approximately 0.1% of the global production, with most sweet potato farming concentrated in Asia and Africa (Orfanidou et al. 2022). As an arable crop, sweet potatoes are commonly cultivated under a monoculture system, where a single crop is grown extensively over large areas, thereby limiting biodiversity. However, its unique characteristics of natural hardiness, wide adaptation, and low care requirements make it an ideal crop for home gardening. Under mixed cropping, the incorporation of sweet potatoes into home gardening offers significant ecological and socioeconomic benefits, while promising a boost in crop production records in the European region. Therefore, this study promotes the adoption of sweet potatoes as a garden crop in Hungary and in similar countries. It presents information on the comprehensive benefits of adopting sweet potato as a garden crop, strategies for overcoming challenges, and simplified cultivation techniques for home gardening. For responsible stakeholders, it also highlights reliable strategies for achieving this goal.

Sweet potato production

Origin

Sweet potato is a root tuber that originated in Central and South America, where it was domesticated more than 5000 years ago. Owing to its adaptability to various climates and soils, its cultivation has spread globally, particularly in Africa and Asia (Drapal et al. 2019). Plant breeders have successfully developed several genotypes with unique qualities for local and international cultivation. Currently, there are a little over 8000 recorded sweet potato accessions worldwide (Luo et al. 2023). Some widely known international genotypes include 'Beauregard', 'Covington', and 'Jewel'. Data from the Food and Agriculture Organization of the United Nations show an almost consistent increase in sweet potato production and harvested area from 2019 to 2023 (Fig. 2). Today, sweet potato is the sixth most important food crop worldwide, contributing significantly to food and nutrition security and income of many farming families, particularly in underdeveloped and developing countries.

Morphological description

The morphological description of sweet potatoes encompasses a wide range of characteristics across the leaves, flowers, stems, and tubers (Fig. 3). These traits not only reflect the genetic diversity within the species but also play a significant role in the botanical classification, adaptability, and agricultural productivity of plants. Sweet potato leaves are typically heart-shaped or lobed, deep green in color, and vary in size and texture, depending on the cultivar. Studies have shown that leaf traits, including pubescence and vein pigmentation, are significant descriptors for differentiating sweet potato varieties (Hue et al. 2012). Sweet potato flowers are typically funnel-shaped and can vary in color, including white, yellow, and purple. Flowering patterns also vary among cultivars, with some exhibiting more prolific flowering than others, which can affect pollination and subsequent tuber development (Alfredo et al. 2023). Sweet potato stems are characterized by climbing or trailing growth habits, with a tendency to produce adventitious roots at the nodes. Stem characteristics are essential for a plant's ability to compete for light and nutrients, particularly in dense planting systems (Laurie et al. 2014). The storage roots of sweet potatoes are the most economically important parts of the plant and exhibit considerable morphological diversity. Storage roots can vary in shape (e.g. elongated or round), size, skin color (e.g. orange, purple, or white), and flesh color, which are critical traits for consumer preference and marketability (Semenenko et al. 2023; Yuan et al. 2023). Understanding the morphological diversity of sweet potatoes highlights their adaptability and agricultural potential and sets the stage for exploring their rich nutritional profile.

Nutritional profile and health benefits

Nutritionally, sweet potatoes are rich in carbohydrates, particularly starch, which constitutes 60–70% of their dry weight. Orange-fleshed varieties are particularly noted for their high beta-carotene content, a precursor of vitamin A that is essential for maintaining healthy vision, immune function, and skin health (Cartabiano-Leite et al. 2020). Studies have indicated that sweet potatoes contain significantly higher levels of polyphenols than other root vegetables, contributing to their antioxidant properties, which may protect against oxidative stress (Ellong et al. 2014; Cao et al. 2022). Moreover, they are a good source of vitamins C and E, which are known for their protective effects against various health conditions, including premature aging and certain cancers (Mohanraj and Sivasankar 2014). The presence of dietary fiber in sweet potatoes also aids in digestive health, potentially reducing the risk of gastrointestinal

Fig. 3 Morphological descriptions of sweet potato leaves (**A**), storage roots (**B**, **C**), vine (**D**), and flower (**E**). (Source: Authors)

disorders (Kamal et al. 2014; Hussin et al. 2023). A summary of the nutritional composition and health benefits of sweet potatoes based on the plant part is presented in Table 1.

Uses of sweet potato

In Hungary, the versatility of sweet potatoes allows for their incorporation into various culinary and industrial applications. Sweet potatoes can be utilized in traditional dishes and baked foods and as a substitute for wheat flour in gluten-free products (Tortoe et al. 2017; Mitiku et al. 2018). Research has shown that sweet potato flour can be blended with wheat flour to enhance the nutritional profile of baked foods, such as bread and pastries, while improving their sensory qualities (Ju et al. 2017). This is particularly relevant in Hungary, where bread is a staple food, and the integration of sweet potato flour could diversify the nutritional content of these products. Sweet potatoes can be prepared in various forms, including soups, stews, and desserts, using traditional Hungarian cooking methods, making them appealing to a wider range of consumers (Kamal et al. 2014; Cartabiano-Leite et al. 2020). The potential of sweet potatoes to be processed into snacks and other convenience foods also aligns with contemporary dietary trends that favor healthy, ready-to-eat options (Tortoe et al. 2017). The use of sweet potatoes transcends culinary levels. They are used in the production of various non-food products, such as adhesives and cosmetics, and serve as raw materials for bioethanol production (Oliveira et al. 2017; Shen et al. 2018). Its leaves and stems are edible and can be used as vegetables or animal fodder, thereby maximizing their utility (Islam 2006; Akoetey et al. 2017). This multifunctionality supports the principles of agroecology, which emphasize the importance of ecological balance and resource efficiency in agricultural systems (Hafez et al. 2019).

Ecological requirements

Ecologically, sweet potatoes thrive efficiently in well-drained sandy loam soils with a pH range of 5.8–6.5. However, they are also suitable for cultivation in marginal soils owing to their resilience to adverse conditions. As a crop native to tropical and subtropical regions, sweet potatoes require a warm climate with temperatures between 20 and 30 °C and full sunlight exposure for optimal growth and development (Behera et al. 2022; Silva et al. 2023). Adequate water supply is crucial, particularly during the first month after planting, as water stress can significantly reduce the yield (Solihin et al. 2016; Karakas et al. 2021). The prevailing ecological conditions at a location may influence the choice of genotypes and cultivation techniques.

Cultivation techniques

Sweet potato cultivation techniques vary worldwide. Although raised bed planting is the most common method, flatbed planting is recommended under certain conditions. The use of mulch and organic fertilizers, such as chicken manure, tends to significantly enhance plant growth (Silva et al. 2023). Studies have also indicated that sweet potatoes can be used in crop rotation systems to enhance biodiversity and reduce pest pressure (Otálora et al. 2024). As sweet potato is a deep-rooted crop, coupling it with shallow-rooted crops, such as cereals and legumes, is recommended for a rotational plan. Intercropping sweet potatoes with shallow-rooted crops is also ideal, provided that the secondary crop does not shade the sweet potato plant. Mechanization is increasingly being adopted to improve efficiency, particularly in regions with high labor costs (Krochmal-Marczak et al. 2020). However, under the home gardening system, the use of human labor is significantly efficient and tends to offer optimum benefits (Fernandes and Ribeiro 2020). As a vegetatively propagated crop, conventional propagation methods involve the use of stem cuttings, slips, and storage

Table 1 Nutritional composition and health benefits of sweet potato

Plant part	Nutritional composition (Approximate %)	Key micronutrients	Health benefits	References
Storage roots	Carbohydrates: 20–27% Fiber: 3–4% Protein: 1–2% Fat: <0.2% Water: 70–75%	β-carotene (Vitamin A), Vitamin C, B6, Potassium, Manganese	Energy source; supports vision and immunity; regulates blood pressure; antioxidant protection	Franková et al. (2022)
Leaves	Protein: 4–7% Carbohydrates: 8–10% Fiber: 2–3% Fat: <1% Water: 80%	Vitamin C, E, K, Calcium, Iron, Polyphenols	Boosts immunity; antioxidant and anti-inflammatory; supports bone and blood health	Nguyen et al. (2021)
Stem/Vines	Protein: 2–3% Carbohydrates: 5–6% Fiber: 1–2% Water: 85%	Magnesium, Phosphorus, Vitamin C, Flavonoids	Aids digestion; supports metabolism; mild antioxidant properties	Makori et al. (2020)
Peels	Fiber: 8–10% Carbohydrates: 10–15% Protein: 1–2% Water: 75%	Polyphenols, Vitamin C, Anthocyanins	Improves gut health; supports heart health; regulates blood sugar	Cao et al. (2022)

roots. However, this approach poses significant challenges, such as a slower rate of propagation and the production of unhealthy propagules. Thus, the adoption of tissue culture as a propagation method is currently on the rise, as it tends to eliminate the challenges associated with conventional methods (Adu Donyina et al. 2025). This technique involves the careful selection and preparation of suitable explants, thorough disinfection of the prepared explants, and culturing of the disinfected explants on a suitable growth medium under aseptic conditions. The developed plantlets are transferred to potted soils, gradually acclimatized to outdoor conditions, and then transplanted to the field for continuous growth and development (Fig. 4). Therefore, this approach should be used to produce and supply propagules for home gardeners.

Similar to other crop species, sweet potato cultivation begins with land preparation. This involves land clearing, levelling, soil inoculation, and layout, as well as the incorporation of organic manure through ploughing (Fig. 5). When the source of manure is animal droppings, adequate time must be provided post-ploughing to allow for efficient decomposition before planting. Ploughing is also necessary to loosen the soil because sweet potatoes require loose soil for efficient root growth and tuberization. Slips obtained from reliable sources are commonly used as planting materials. Planting is performed by slightly pushing the bottom 3–4 nodes of the slip into the soil. This can be performed manually in home gardens. The complete emergence of plant leaves signifies the successful establishment of the planted slips. This is usually observed three to 4 weeks after planting. Following successful plant establishment, vegetative growth, storage root initiation, tuber bulking, maturation, and harvest occur in a successive order. A summary of the significant characteristics, cultivation activities, and timelines of each growth stage is presented in Table 2.

Pest and disease management

Pest and disease management in sweet potato production involves integrated approaches that combine cultural practices, biological control, and chemical methods. Traditional practices such as earthing-up, mulching, and early harvesting can help suppress pest attacks (Ezeano 2011). Genetic resistance to pests and diseases has been explored in breeding programs, and significant genetic variability has been identified in sweet potato populations (Naidoo et al. 2016). Biotechnology is also being leveraged to enhance resistance to biotic stresses, thereby improving overall crop resilience (Yang et al. 2023).

Integration into home gardening

The integration of sweet potatoes into Hungarian gardens aligns with sustainable farming practices. Sweet potatoes require less water than most vegetable crops, such as tomatoes and carrots, making them an environmentally friendly

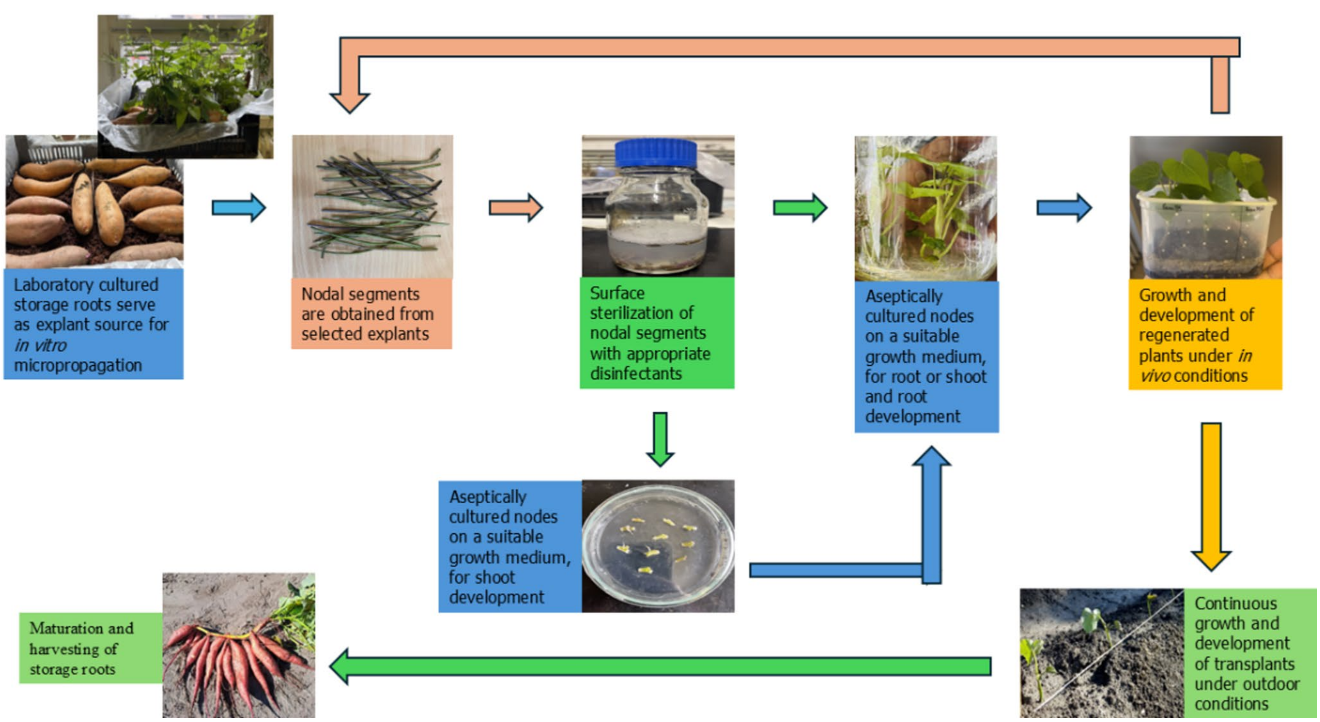

Fig. 4 Schematic description of the stages involved in sweet potato cultivation using the tissue culture method. (Source: Adu Donyina et al. 2025)

Fig. 5 Pictorial description of sweet potato cultivation and development process from planting to harvest. **A** Soil plowing, lining, and pegging. **B** Seedling planting at a uniform distance. **C**, **D** Early stages of growth. **E** Mid-stage of plant growth and development. **F**, **G** Final stages of plant growth and development. **H**, **I** Harvesting of mature storage roots. (Source: Authors)

Table 2 Phenological growth stages of a sweet potato plant

Weeks	Cultivation activity	Growth stage	Growth stage characteristics
0	Land preparation		
1–4	Planting of slips/cuttings, irrigation, and weed control	Sprouting and establishment	Slips develop roots, first leaves emerge, and plants establish themselves
4–8	Fertilization, weed control, and vine training	Vegetative growth	Rapid vine elongation, leaf expansion, and canopy formation
8–11	Monitoring nutrient levels, pest control	Storage root initiation	Some adventitious roots start thickening into early tubers, increased nutrient uptake
11–17	Regular watering, fertilization, pest & disease management	Tuber bulking	Tubers grow significantly in size as carbohydrates accumulate, peak biomass production
17–22	Reduced watering, monitoring for maturity indicators	Maturation	Tuber skin thickens, vine yellowing begins, plant redirects energy to tubers
22+	Harvesting, curing, and storage preparation	Harvest and post-harvest	Tubers are dug and cured at warm temperatures to enhance sweetness and heal wounds. Proper storage maintains quality

option in the context of climate change and water scarcity (He et al. 2022). Additionally, sweet potatoes can improve soil health by preventing erosion and enhancing soil structure, thereby contributing to the sustainability of agricultural practices in Hungary (Otálora et al. 2024). Incorporating sweet potatoes into a crop rotation system with cereals and legumes not only benefits the environment but also supports the economic viability of farming operations by diversifying income sources (Aldow and Feyissa 2023).

Home gardening in Hungary

Home gardens in Hungary are characterized by a rich diversity of plant species that reflect local agricultural practices and cultural preferences. The cultivation of traditional Hungarian vegetables, herbs, and fruits is common, with many gardeners opting for organic practices that emphasize sustainability and biodiversity (Centeri et al. 2021). This biodiversity not only supports ecological health but also contributes to the resilience of local food systems, allowing households to adapt to changing environmental conditions and market fluctuations (Mulia et al. 2022; Makhubu et al. 2024). In addition, the use of non-synthetic fertilizers, such as manure, is prevalent, aligning with the broader trend toward environmentally friendly gardening practices (Varga-Szilay et al. 2023).

Strategic framework for promoting sweet potato as a garden crop in Hungary

Promoting sweet potato as a garden crop in Hungary presents a unique opportunity to enhance the local food system and improve food and nutrition security. By implementing educational campaigns, developing robust supply chains, promoting value-added products, addressing cultivation challenges, promoting community gardens, and emphasizing sustainable practices through stakeholder cooperation, sweet potatoes can be successfully adopted as a garden crop (Fig. 6). The integration of these strategies will benefit home gardeners and consumers and contribute to the overall resilience and sustainability of the agricultural sector in Hungary.

Mass education and awareness creation

Education and awareness campaigns targeting both consumers and farmers are essential. These campaigns can highlight the health benefits of sweet potatoes, such as their low glycemic index and high antioxidant content, which can appeal to health-conscious consumers (Yadnya et al. 2016; Aritonang et al. 2017). Additionally, educational initiatives aimed at improving gardening skills and knowledge are essential for empowering households to engage in productive gardening (Warner et al. 2017; Asante et al. 2024). Workshops and demonstrations could be organized to educate farmers and households about cultivation techniques, pest management, and post-harvest handling of sweet potatoes, thereby increasing their confidence in growing this crop (Ezin et al. 2018; Hamidah et al. 2021). Sustainable agricultural practices should be emphasized to promote sweet potato cultivation. Encouraging organic farming methods and integrated pest management (IPM) can enhance soil health and reduce the environmental impact of sweet potato farming (Woo et al. 2013). Moreover, educating farmers on crop rotation and intercropping with other vegetables can improve soil fertility and reduce pest pressure, leading to more sustainable production systems (Pepó 2018; Bahati et al. 2021).

Establishment of a robust supply chain

Establishing a robust sweet potato supply chain is crucial for its widespread adoption as a garden crop. This includes partnerships with local grocery stores and farmers' markets to ensure that sweet potatoes are readily available to consumers (Soto-Caro et al. 2022; Bordé-Pavlicz et al. 2024).

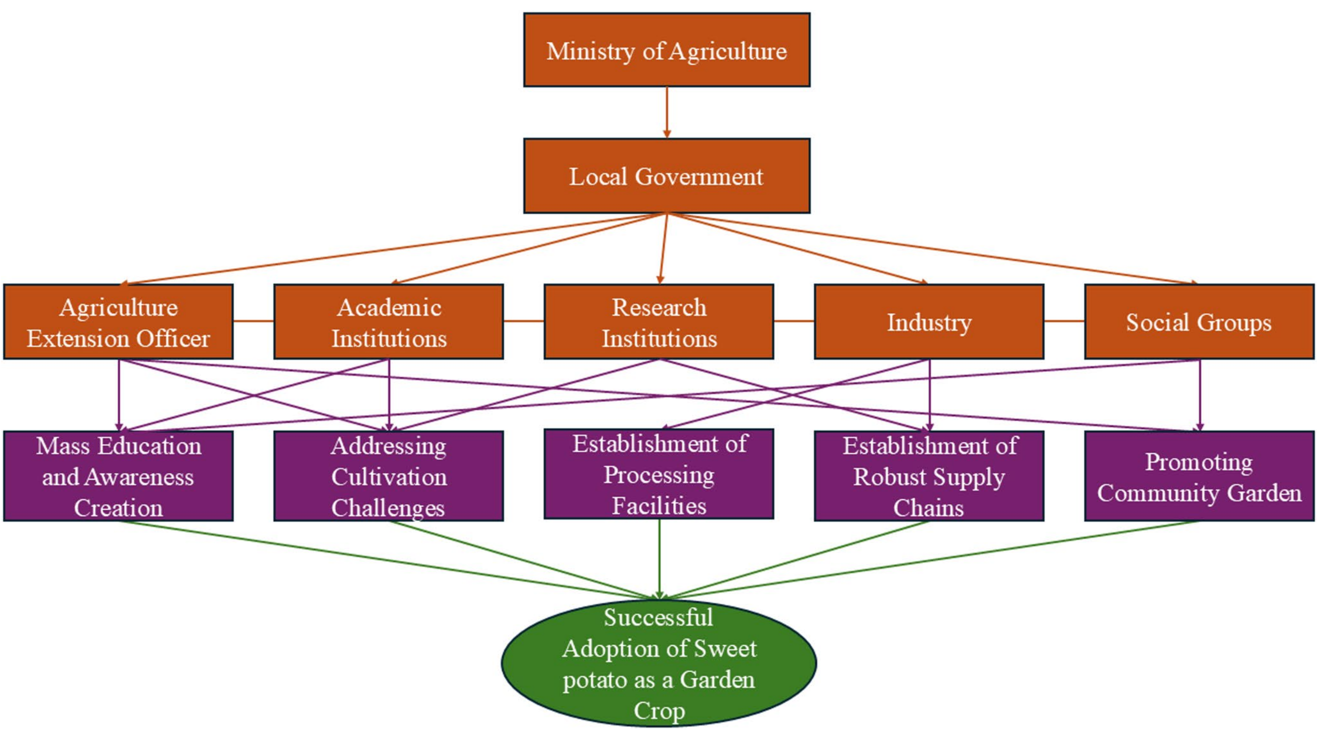

Fig. 6 Strategic framework for the successful widespread adoption of sweet potato as a garden crop in Hungary through cooperation among stakeholders (orange) in executing the proposed activities (plum)

Community-supported agriculture programs can also facilitate direct sales from farmers to consumers, enhance the local economy, and promote the consumption of fresh produce (Bende and Nagy 2020). Additionally, leveraging digital marketing strategies can help raise awareness of sweet potatoes and their use in various culinary applications, thereby attracting more customers (Seviana et al. 2023).

Establishment of processing facilities

Another significant opportunity lies in the processing of sweet potatoes into value-added products. Research has shown that sweet potatoes can be processed into various food products, such as flour, noodles, and snacks, diversifying their market potential (Taneya et al. 2014; Fan et al. 2022). By promoting the use of sweet potato flour for baking and cooking, producers can tap into the gluten-free market, thereby appealing to consumers with dietary restrictions (Mahfud and Kusuma 2016; Bordunova et al. 2023). Furthermore, the development of innovative products, such as sweet potato milk and fortified snacks, can enhance the nutritional profile of the local food supply (Busyairi et al. 2022; Rahman and Nurdin 2023). The availability of several agro-processing industries in Hungary is a significant prospect for realizing this initiative.

Promoting community gardens

The role of community gardens in promoting sweet potatoes cannot be overlooked. Community gardens offer an excellent platform for urban residents to engage in gardening, providing access to fresh produce while fostering a community spirit (Bende and Nagy 2020). Community engagement plays a crucial role in the success of Hungary's home gardening initiatives. Collaborative gardening projects and community-supported agriculture programs have emerged as effective strategies for fostering a sense of belonging and shared responsibility among participants (Bársony et al. 2020; Bende and Nagy 2020). These initiatives not only enhance food security but also promote social interaction and community resilience, which are vital in the face of economic and environmental challenges (Garcia et al. 2018; Kersten et al. 2023). By incorporating sweet potatoes into community gardening initiatives, local governments and organizations can promote this crop as a viable option for urban agriculture, thereby enhancing food security in urban areas (Asante et al. 2024).

Addressing cultivation challenges

Addressing the challenges associated with sweet potato cultivation is vital for its promotion. One of the primary concerns is the prevalence of viral diseases that affect sweet potatoes, which significantly reduce their yield. The implementation of a national system for producing pathogen-tested planting materials can help mitigate these risks and ensure that farmers have access to healthy and disease-free plants (Kwak et al. 2014; Kiemo et al. 2022). Research on pest management strategies and the development of disease-resistant cultivars can further support farmers in overcoming these challenges (Lei et al. 2022; Yang et al. 2023). Various academic institutions and agricultural research centers in the country can cooperate to facilitate this role.

Challenges and prospects of sweet potato cultivation in Hungary

Agronomic factors

One of the primary agronomic challenges in sweet potato cultivation is the limited availability of improved genotypes that are well-suited to the Hungarian climate. Many farmers rely on exotic genotypes that may not perform optimally under local conditions. Furthermore, the employed cultivation practices often do not align with the best agronomic recommendations, leading to suboptimal yields. For instance, studies have indicated that sweet potato farmers in Hungary often use traditional farming methods, which can result in lower productivity than modern practices that incorporate advanced agronomic techniques (Pepó 2018; Onuwa et al. 2021).

With the availability of state-of-the-art research centers, plant breeders in Hungary have developed several locally adaptable registered cultivars. These include Ásotthalmi12 and Tápiói 96. The release of these locally adapted and improved cultivars has been shown to enhance sweet potato cultivation by improving crop performance and yields (Kiemo et al. 2022; Nagy et al. 2023). Therefore, educating the public on the uniqueness of these genotypes, their effective cultivation practices, and the relevance of their adoption for cultivation, as well as making micropropagated planting materials accessible, could further improve crop yields.

Pest and disease management

Pest and disease pressure pose a significant threat to sweet potato production in Hungary. The introduction of new pests and diseases, such as the Sweet Potato Chlorotic Stunt Virus (SPCSV), has been documented, complicating management strategies (Fielder et al. 2024). Moreover, the lack of a comprehensive pest management framework can increase the vulnerability of sweet potato crops to outbreaks. Farmers often lack access to timely information regarding pest and disease identification and management, which can hinder their ability to respond effectively (Kiemo et al. 2022). The integration of biocontrol organisms and the development of resistant varieties are potential strategies for mitigating these challenges (Bordé-Pavlicz et al. 2024).

Research conducted in Hungary has focused on the elimination of viruses affecting sweet potato crops, which is crucial for ensuring the production of healthy and high-yielding varieties. This effort is part of a broader initiative to establish a national system for producing pathogen-tested sweet potatoes, thereby enhancing food security and agricultural sustainability in the region (Kiemo et al. 2022). As there are acceptable microbiological products for soil disinfection, pests, and disease control in Hungary, the Ministry of Agriculture, in cooperation with local governments and organizations, could make these substances freely accessible to home gardeners who are into sweet potato cultivation, with education on their proper usage. Moreover, supporting research laboratories can enhance the production of disease-free planting materials through micropropagation. Successful management of sweet potato pests and diseases could increase production and availability, further solidifying the role of this crop in the Hungarian agricultural landscape.

Soil fertility and nutrient management

The sustainability of sweet potato cultivation is closely linked to soil health and its fertility. Continuous cropping without adequate soil management can lead to nutrient depletion and degradation. The soil type in Hungary, particularly sandy soils, can exacerbate these issues as they typically have lower nutrient retention capabilities (Nagy et al. 2023). Sweet potatoes are heavy feeders and require a balanced supply of nutrients, particularly potassium, nitrogen, and phosphorus (Monostori and Szarvas 2023). However, many farmers in Hungary do not practice crop rotation or cover cropping, which are essential for maintaining soil fertility and preventing erosion (Elwaziri et al. 2023; Sapakhova et al. 2023).

Recent studies have explored the potential use of soil amendments in various agricultural settings, including those in Hungary. Nagy et al. (2023) and Marjanović et al. (2024) highlighted the effectiveness of a multicomponent microbiological soil inoculant in enhancing sweet potato and potato yields through the improvement of soil physico-chemical properties. This suggests a growing interest in optimizing cultivation practices to improve productivity, even in marginal soil conditions. Moreover, the use of organic fertilizers, such as manure, has been shown to improve soil health and fertility, thereby increasing sweet potato yields (Hazenbosch et al. 2022). As the net profit of sweet potato production is considerably high owing to its increased demand, the purchase of supplementary fertilizers is a worthwhile investment. Motivating home gardeners to adopt proper cultivation practices, such as crop rotation and the use of locally available organic materials, can enhance soil fertility and crop productivity.

Climatic influence

The soil distribution, climate type, and key weather parameters, particularly for the spring and summer seasons, suggest the successful cultivation of sweet potatoes across all regions of the country (Table 3). However, the adverse effects of climate change remain an overarching challenge affecting sweet potato cultivation in several countries, including Hungary. Variability in weather patterns, including irregular rainfall and extreme temperature fluctuations, can adversely affect crop growth and yield (Mikó et al. 2025). Sweet potatoes are sensitive to water and temperature stress, and changes in weather patterns can lead to cold, hot, drought, or waterlogged conditions, all of which are detrimental to crop health (Pushpalatha and Gangadharan 2024).

The natural hardiness of sweet potato could be particularly beneficial for Hungarian farmers seeking to mitigate the risks associated with climate change, thus enhancing the resilience and sustainability of production. Moreover,

Table 3 Soil distribution, climate type, and weather parameters of Hungary

Region	Climate type	Soil type	Relative humidity	Sunlight (hrs./season)	Avg temp. (°C)	Rainfall (mm/season)
Great Hungarian plain	Continental, arid to semi-arid	Chernozem, sandy, saline	Low, dry summers	Spring: 500–600 Summer: 800–900	Spring: 10–18 Summer: 20–27	Spring: 100–150 Summer: 150–250
Transdanubia	Continental, moderate precipitation	Brown forest soils, loess, chernozem	Moderate, balanced	Spring: 400–550 Summer: 700–850	Spring: 9–17 Summer: 19–26	Spring: 120–180 Summer: 200–300
Northern Hungary	Continental, cooler, humid	Ranker, brown forest, lithosols	High, humid summers	Spring: 350–500 Summer: 600–750	Spring: 7–15 Summer: 17–24	Spring: 150–200 Summer: 250–350
Western Hungary	Sub-Alpine, humid	Brown forest soils, podzols	High, year-round moisture	Spring: 300–450 Summer: 550–700	Spring: 6–14 Summer: 16–23	Spring: 200–250 Summer: 300–400
Lake balaton and surroundings	Continental, mild winters	Sandy soils, rendzina	Moderate, humid near the lake	Spring: 450–600 Summer: 750–900	Spring: 10–18 Summer: 20–27	Spring: 120–170 Summer: 200–280

research indicates that developing climate-resilient sweet potato varieties could help mitigate some of these impacts; however, such initiatives require significant investments in research and development (Pushpalatha and Gangadharan 2024). Therefore, enhancing farmers' adaptive capacity through education and access to climate-resilient inputs is crucial for sustaining sweet potato production in Hungary.

Limited research output

Several studies on sweet potatoes have been conducted in Hungary. For instance, Bordé-Pavlicz et al. (2024) described the role of endophytic microorganisms in enhancing pest control during sweet potato cultivation. Kiemo et al. (2022) also highlighted the successful elimination of multiple viruses from distinct sweet potato genotypes and the establishment of a national pathogen-tested sweet potato propagation system in their work. While the scope of these contributions seems to be narrowed to the plant protection aspect of sweet potato cultivation, there is a considerably smaller amount of research output on this crop (Fig. 7). A holistic research approach is required to achieve an overall enhancement of sweet potato production in Hungary. In collaboration with various academic and research institutions, the Ministry of Agriculture can upscale sweet potato research in the country. The scope of these experiments should cover the production, protection, harvesting, and marketing of sweet potatoes in Hungary. The availability of several state-of-the-art research institutions is a significant prospect for achieving this goal.

Socio-economic aspects

Access to markets is often hindered by inadequate infrastructure and a lack of organized marketing systems, which can result in post-harvest losses and reduced income for farmers. Furthermore, the socioeconomic status of home gardeners tends to influence their ability to invest in improved agricultural practices and technology. Many smallholder farmers face financial constraints that limit their access to high-quality seeds, fertilizers, and pest management solutions (Onuwa et al. 2021; Osuji et al. 2023). These economic barriers limit the potential for agricultural development in the region.

However, the positive economic aspects of sweet potato cultivation cannot be overlooked. Sweet potatoes can be harvested over an extended period and provide a steady source of income for farmers, particularly in rural areas where agricultural diversification is essential for economic stability (Saediman et al. 2021). The growing sweet potato market in Hungary reflects a shift toward more sustainable and health-oriented agricultural practices, aligning with global food consumption trends (Bordé-Pavlicz et al. 2024; Islam 2024). Research from Poland indicates that sweet potato farming can be economically efficient under certain conditions, suggesting that similar economic assessments in Hungary could encourage more farmers to consider sweet potatoes as a viable crop option (Krochmal-Marczak et al. 2020). Additionally, the potential for sweet potatoes to be processed into various products, such as flour and noodles, could enhance their marketability and profitability for Hungarian farmers (Taneya et al. 2014). The ability to locally produce sweet potatoes can reduce reliance on imported food products, thereby enhancing national food security and supporting local economies (Sanoussi et al. 2016). Therefore, educating the public on these economic prospects could encourage the active participation of youth in sweet potato farming and attract local and foreign investors. In addition, the operation of community gardens and local organizations in Hungary could facilitate sweet potato advertising and marketing for producers. A summary of the challenges and prospects associated with sweet potato cultivation in Hungary is presented in Table 4.

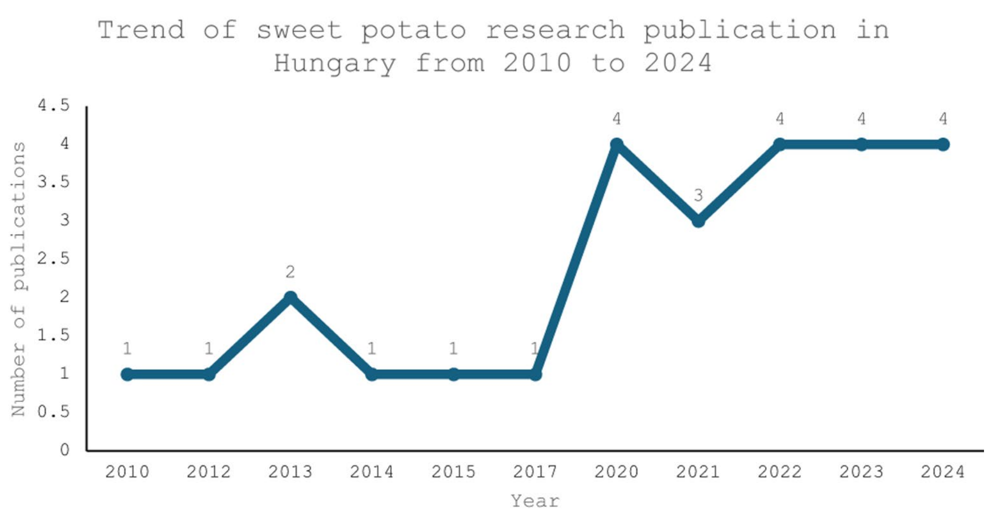

Fig. 7 Trend in sweet potato research publication in Hungary from 2010 to 2024. (Source: Scopus database)

Table 4 Summary of the challenges and prospects of sweet potato cultivation in Hungary

Category	Challenge	Prospect
Agronomic factors	Limited availability of improved sweet potato varieties Reliance on traditional farming methods leading to lower yields	Development of locally adaptable genotypes (e.g., Ásotthalmi12, Tápiói 96) Availability of academic institutions and extension officers to provide training on improved cultivation techniques
Pest and disease management	Presence of new pests and diseases (e.g., Sweet Potato Chlorotic Stunt Virus - SPCSV), Lack of a comprehensive pest management framework	Ongoing research on the establishment of pathogen-free sweet potato production systems in the country The dense foliage nature of the crop
Soil fertility and nutrient management	Soil degradation and nutrient depletion due to continuous cropping Lack of rotation and soil improvement practices	The existing use of microbiological soil inoculants to improve yields Availability of academic institutions and extension officers to provide training on proper cropping techniques
Climatic influences	Irregular rainfall and extreme temperatures affecting yields Increased risk of abiotic stress due to climate change	Sweet potatoes' adaptability to diverse climates. Favorable weather in Spring, Summer, and Fall Availability of expert plant breeders to develop climate-resilient varieties with investment in research
Limited research output	Narrowed scope of publications on sweet potato A relatively smaller number of publications on sweet potato cultivation	Several agriculture-related state-of-the-art research institutions are available in the country
Socio-economic aspects	Poor market access due to inadequate infrastructure Financial constraints for smallholder farmers and gardeners	Availability of local organizations to promote sweet potato marketability Growing market demand and potential for value-added products (e.g. flour, noodles) Provision of free or subsidized inputs from the government

Conclusions for future biology

In conclusion, this review highlights the multifunctionality of sweet potatoes and home gardens, the significance of adopting sweet potato as a garden crop in Hungary, and offers a strategic framework for successful adoption. Sweet potato is a 'super' crop with diverse uses and benefits in the fields of nutrition, health, ecology, industry, and socio-economic development. On the other hand, home gardens play a crucial role in the development of a robust agri-food system and offer a buffer against crises. The coupling of these items promises exponential benefits for humans and the environment. Although there are existing challenges, this study reveals that Hungary has the potential to overcome them. The unique attributes of this crop that allow it to thrive in marginal soils and withstand unfavorable weather conditions have been highlighted as key prospects. In addition, the existence of the Ministry of Agriculture, local governments, state-of-the-art research institutions, academic universities, and social organizations underscores the country's capacity to successfully implement this initiative. Therefore, collaboration among stakeholders is strongly recommended. However, this review also highlights some critical issues for consideration. First, the inaccessibility of reliable data on sweet potato production in the country is a problem. The role of data in research and development cannot be overstated. Therefore, to enhance sweet potato production in Hungary, we recommend the release of data by relevant institutions for research and policy-making. Thus, significant research gaps can be identified, and necessary initiatives can be taken to bridge these gaps. Additionally, a thorough search conducted on Scopus revealed a significantly smaller number of studies on sweet potato production in Hungary. Therefore, we call on the government to support academic and research institutions in projects focusing on sweet potato production. By addressing these gaps, we can successfully implement this initiative and ultimately achieve a significant increase in sweet potato production in Hungary. This study could also serve as a blueprint for other European countries to enhance their crop production.

Author contributions GAD and AU conceived the idea. designed the study, performed the literature search, and drafted the manuscript. VOA, LB, and AS critically reviewed and edited the manuscript. TM performed the overall supervision. The final manuscript was approved by all the authors.

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